

Amendments to the Claims:

Please amend the claims as shown in the Listing of Claims below. The listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS WITH MARKINGS TO SHOW CHANGES MADE

1. (original) A thermally activatable antioxidant precursor compound of the formula:



wherein A and B are the same or different, each consisting of a moiety other than a hydrogen atom; and

wherein A and B are connected via a labile bond, and are able to dissociate through breakage of the labile bond upon exposure of said compound to a predetermined temperature shift from a lower temperature to a higher temperature, thereby to generate corresponding free radicals A• and B• at least one of which being suitable for use as an antioxidant.

2. (currently amended) The thermally activatable antioxidant precursor compound of claim 1, wherein each of A and B comprises a monocyclic aromatic or polycyclic aromatic ring system, optionally substituted at one or more positions[[]] and optionally comprising a heterocyclic ring.

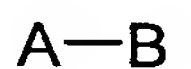
3. (original) The thermally activatable antioxidant precursor compound of claim 1, wherein the labile bond is a carbon-carbon bond and each of the free radicals A• and B• is a carbon centered free radical.

4. (cancelled)

5. (cancelled)

6. (cancelled)

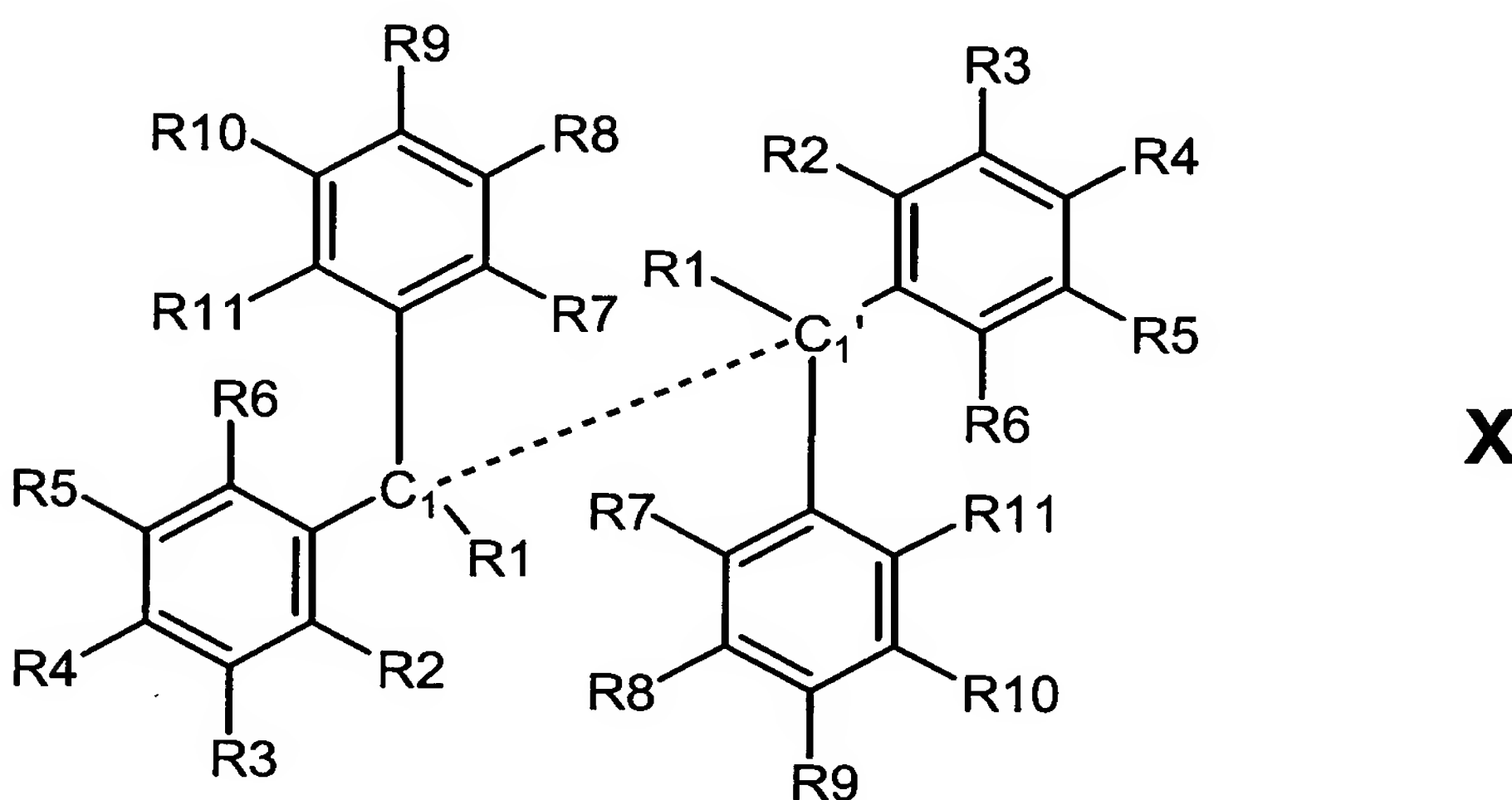
7. (original) The thermally activatable antioxidant precursor compound of claim 1, wherein the free radicals A• and B• are able to re-associate through the formation of a labile bond upon exposure of said radicals to a predetermined temperature shift from a higher temperature to a lower temperature thereby to regenerate the corresponding antioxidant precursor compound of the formula:



8. (cancelled)

9. (cancelled)

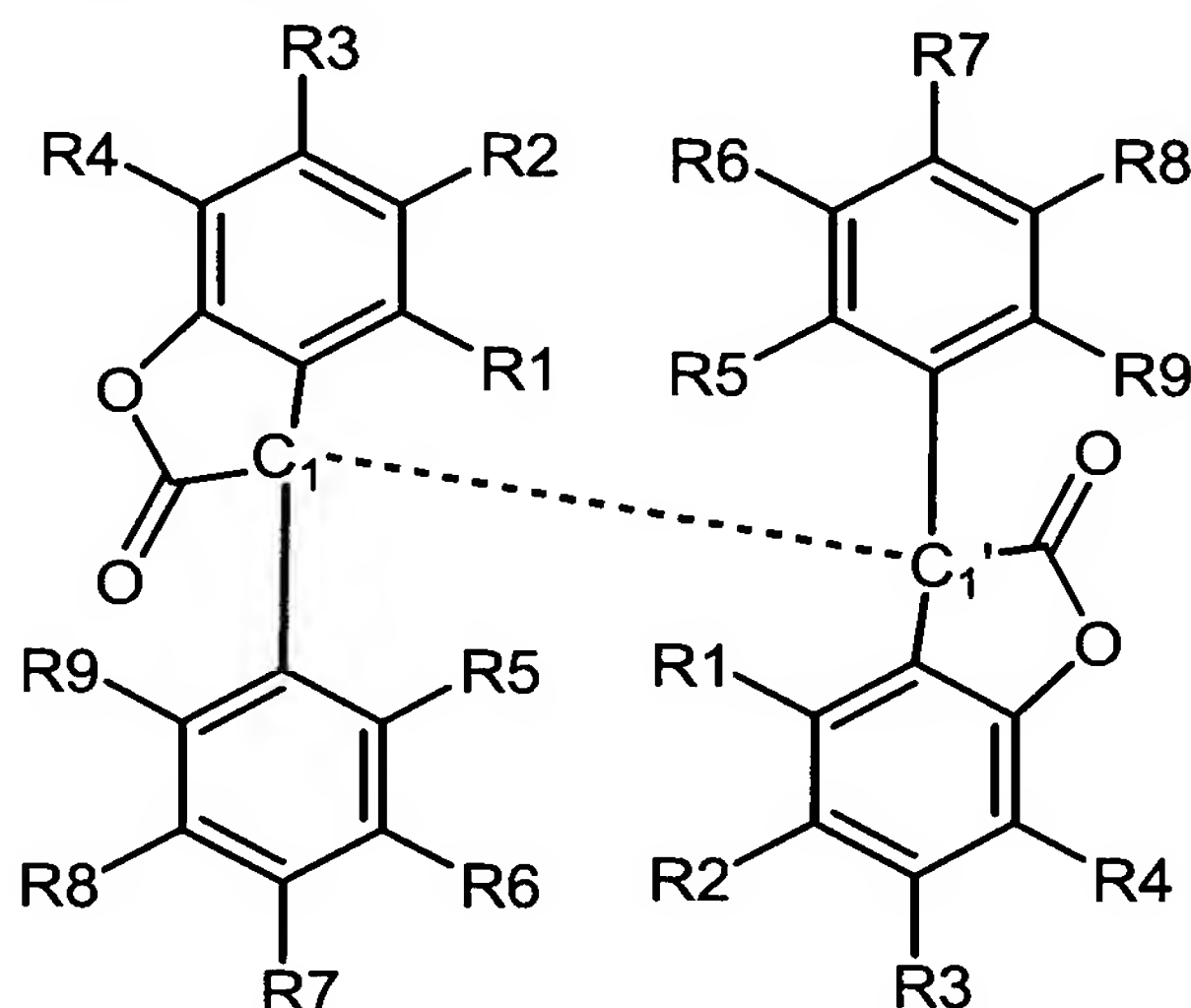
10. (currently amended) The thermally activatable antioxidant precursor compound of claim 1, wherein the compound A-B is selected from a compound[[s]] of the formula X:



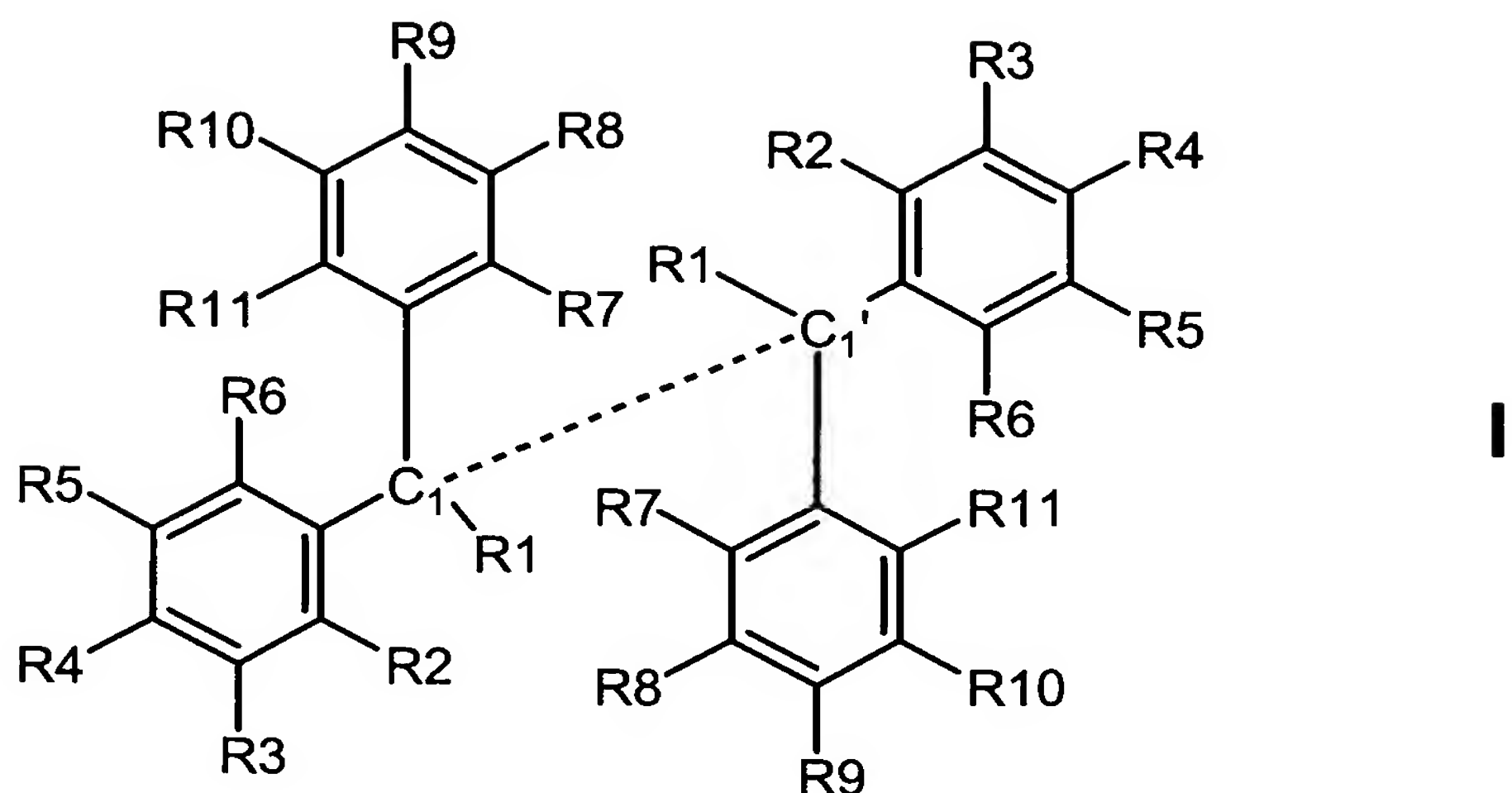
wherein the dashed line represents the labile bond susceptible to breakage upon exposure of said compound to a temperature shift from a lower temperature to a higher temperature; and wherein R1-R11 are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R₁₆ (where R₁₆ comprises hydrogen or a ~~substituant~~ substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl optionally substituted

with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl,

and wherein optionally any two of R₂ to R₁₁ within the same moiety of A or B may be linked to form a substituted or unsubstituted bicyclic or polycyclic ~~fused ring~~ fused ring system, and wherein optionally R₁ may be linked to one or more of R₂, R₆, R₇, and R₁₁ within the same moiety of A or B, to form a substituted or unsubstituted bicyclic or polycyclic fused ring system optionally comprising one or more heterocyclic rings[.];
or a compound of formula I:



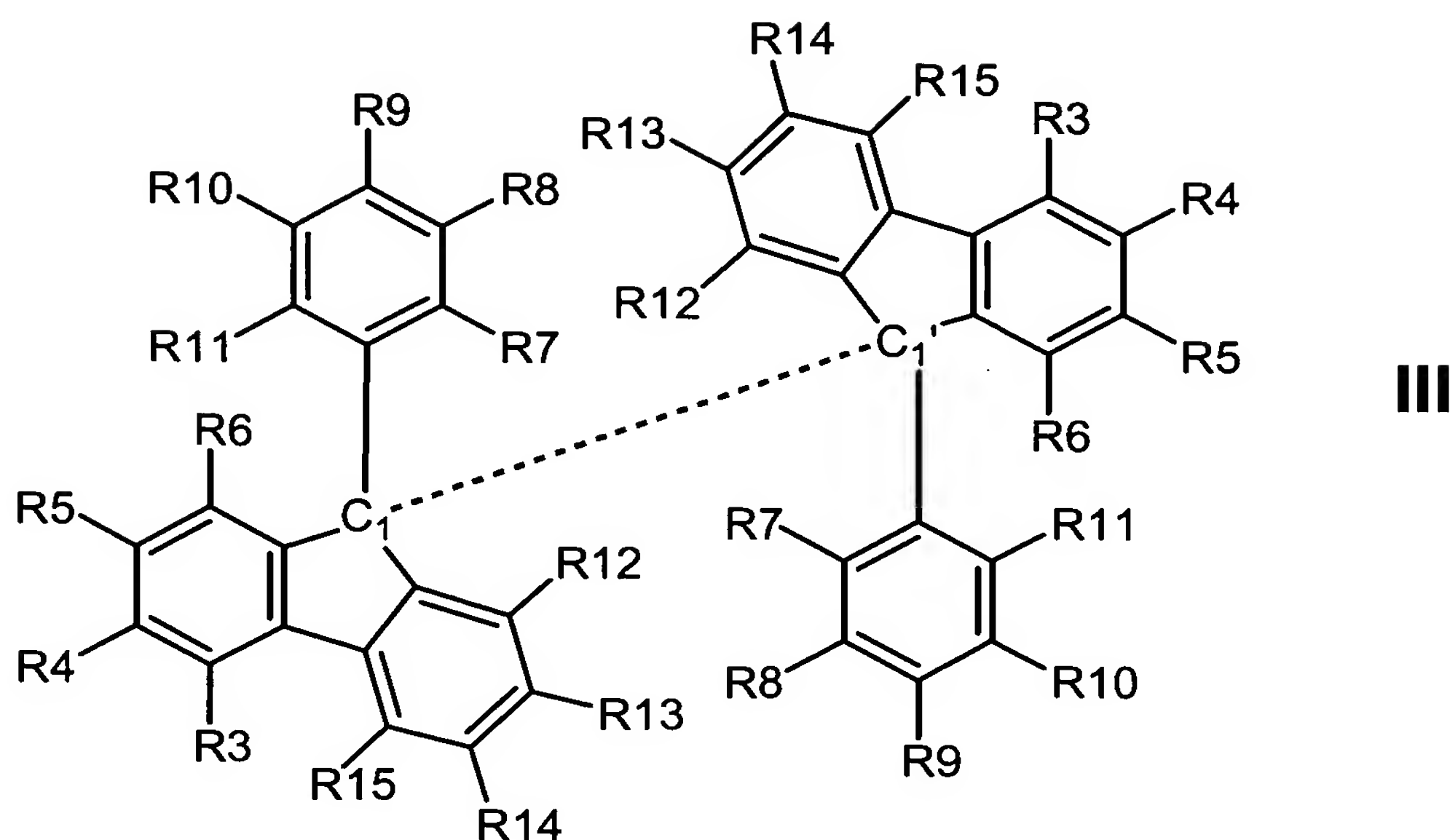
wherein the dashed line represents the labile bond susceptible to breakage upon exposure of said compound to a temperature shift from a lower temperature to a higher temperature; and wherein R₁ to R₉ are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R₁₆ (where R₁₆ comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl;
or a compound of formula II:



wherein the dashed line represents the labile bond susceptible to breakage upon exposure to a higher temperature; and

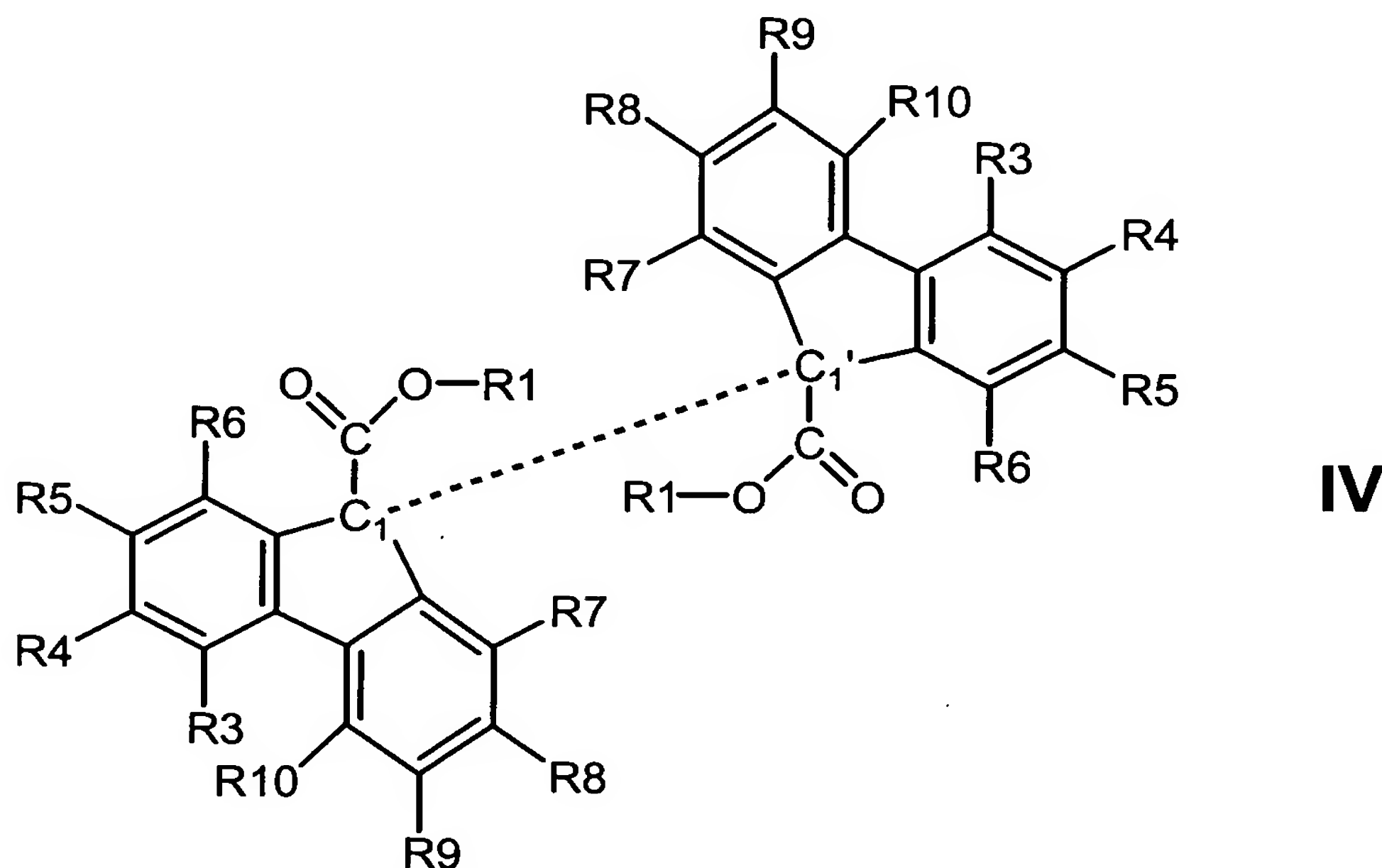
wherein R1 represents an electron withdrawing group optionally selected from CN, CHal₃ (where Hal=Cl, Br or F), CO₂R16 (where R16 comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), and NO₂.

R2-R11 are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R16 (where R16 comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl; or a compound of formula III:

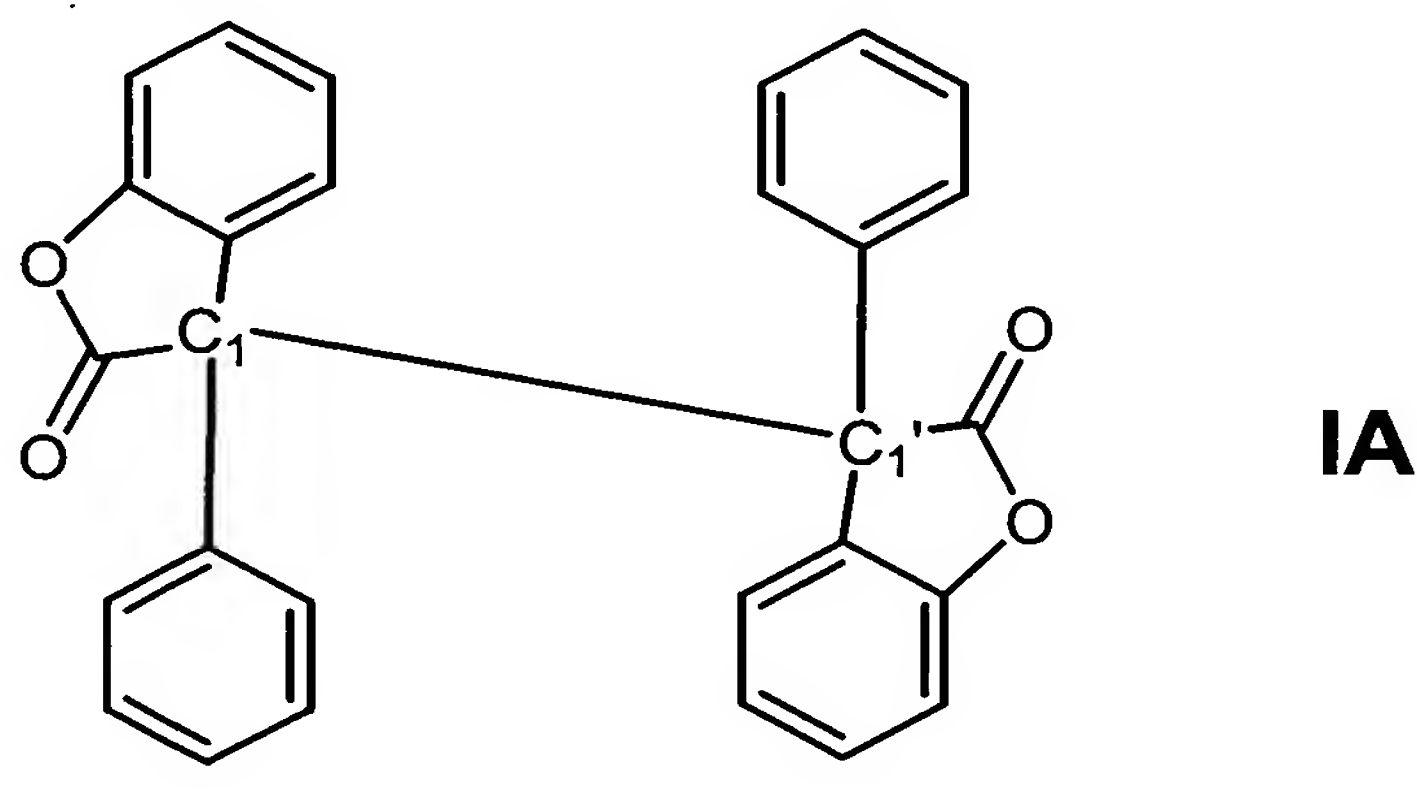


wherein the dashed line represents the labile bond susceptible to breakage upon exposure to a higher temperature; and

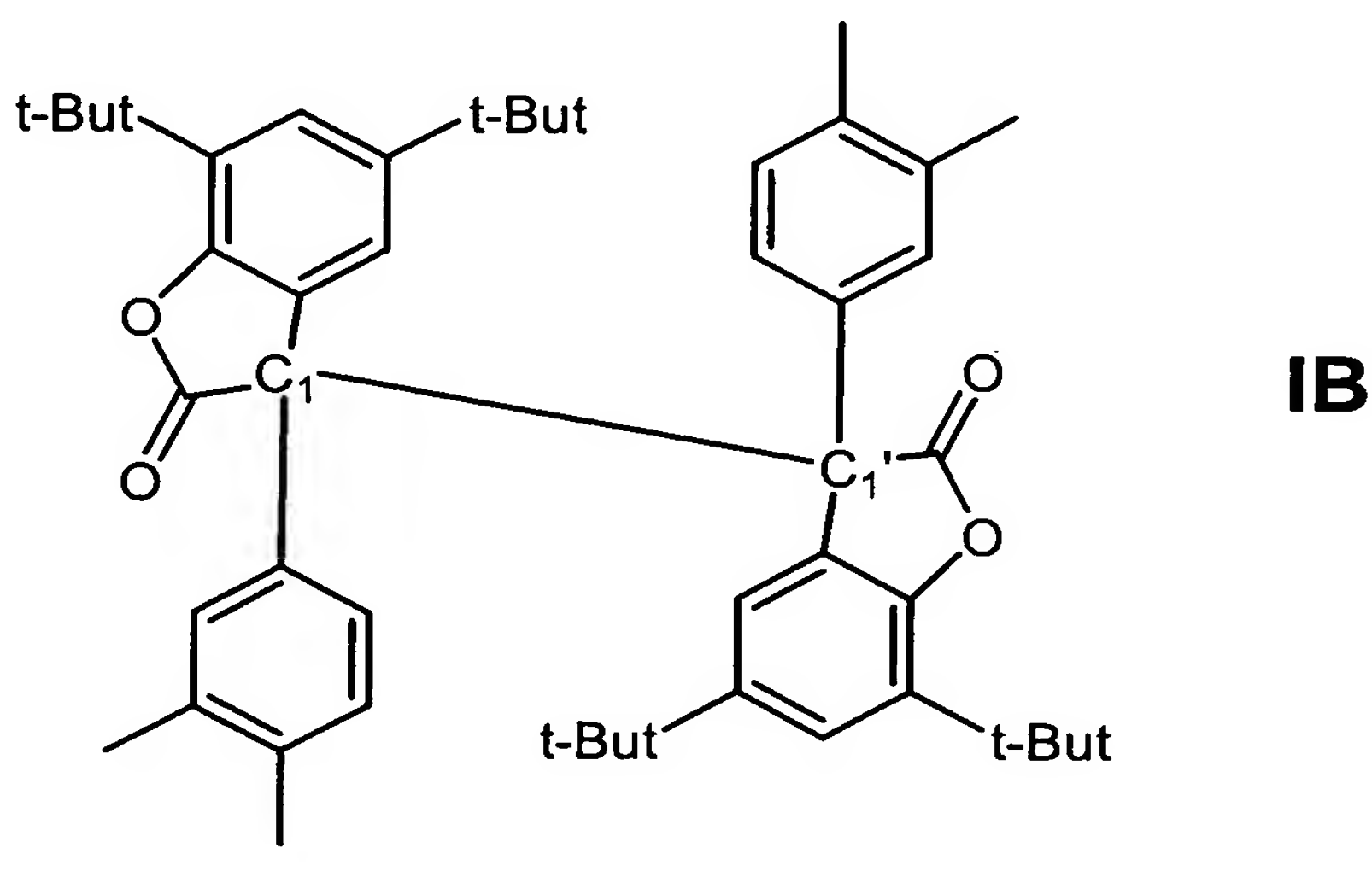
wherein R3-R15 are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R₁₆ (where R₁₆ comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl; or a compound of formula IV:



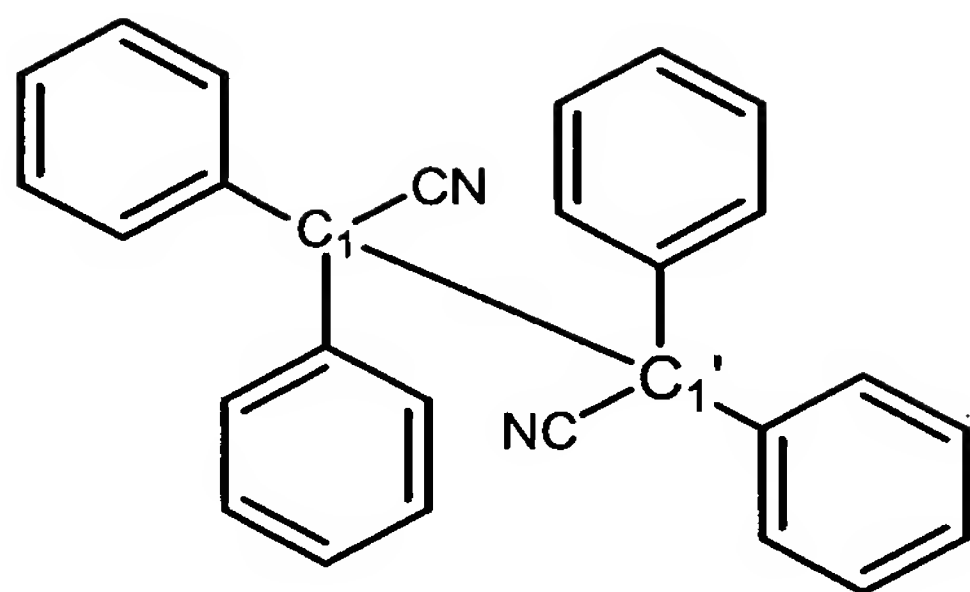
wherein the dashed line represents the labile bond susceptible to breakage upon exposure to a higher temperature; and
 wherein R1 and R3-R10 are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R16 (where R16 comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl; or
 a compound of formula IA:



or a compound of formula IB:

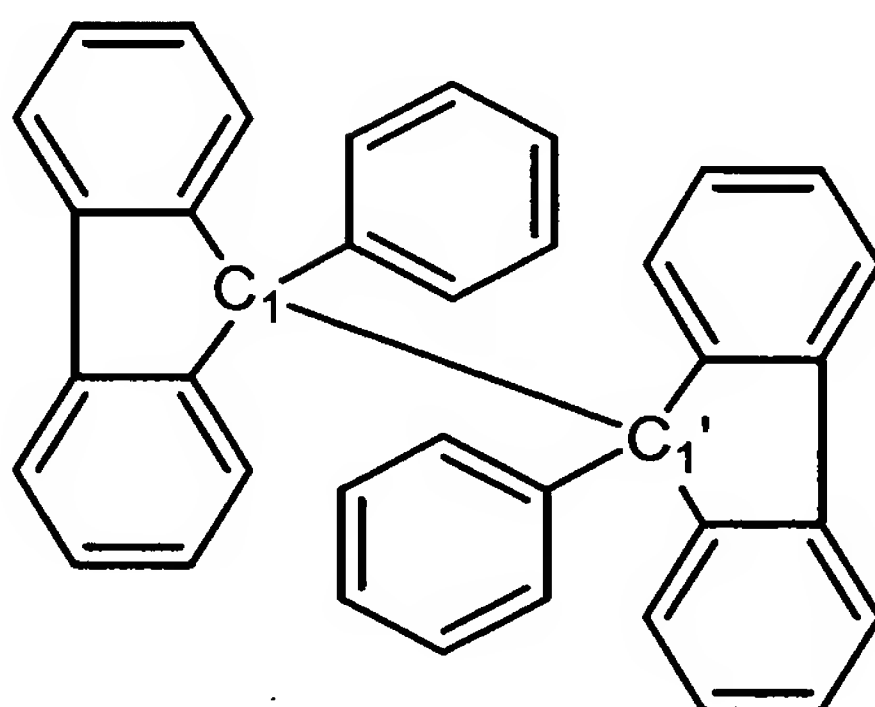


or a compound of formula IIA:



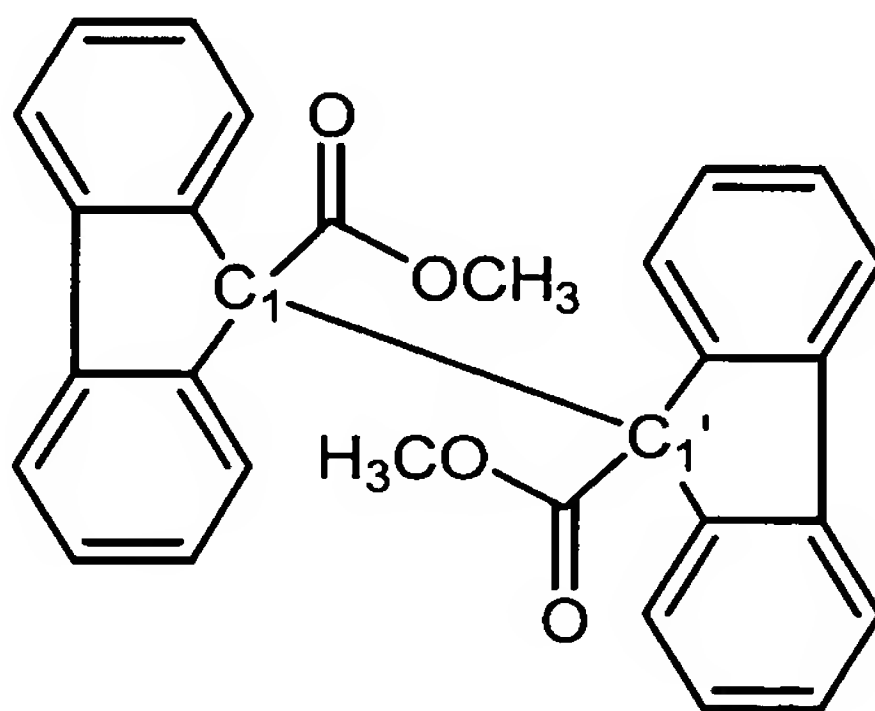
IIA

or a compound of formula IIIA:



IIIA

or a compound of formula IVA:



IVA

11. (cancelled)

12. (cancelled)

13. (cancelled)

14. (cancelled)

15. (cancelled)

16. (cancelled)

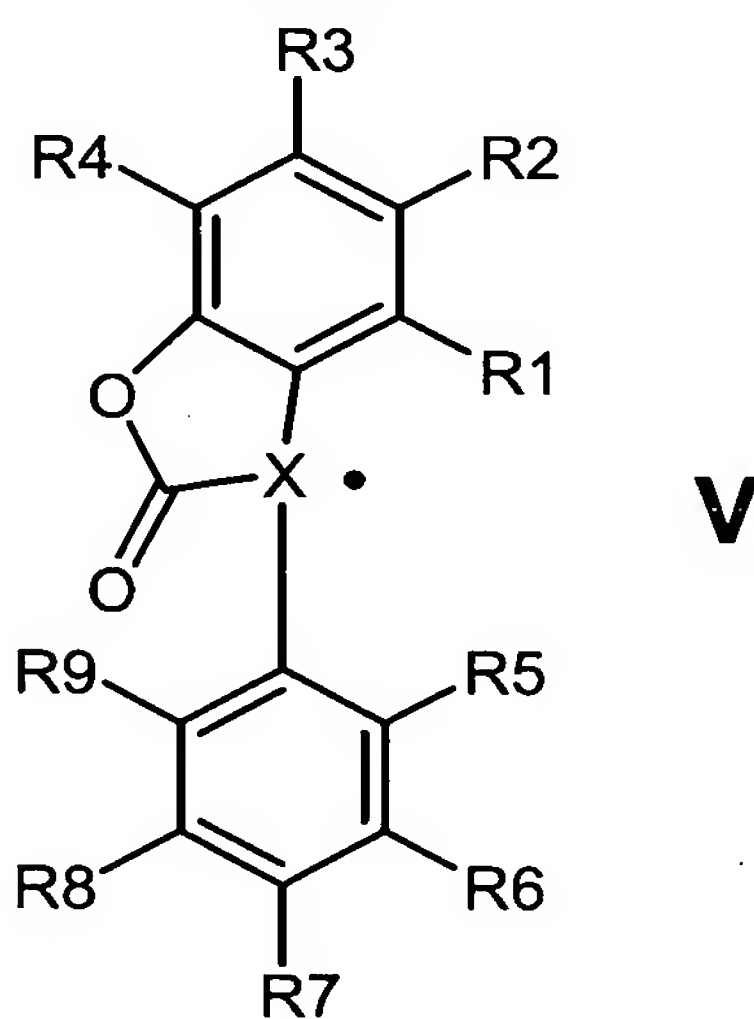
17. (cancelled)

18. (cancelled)

19. (cancelled)

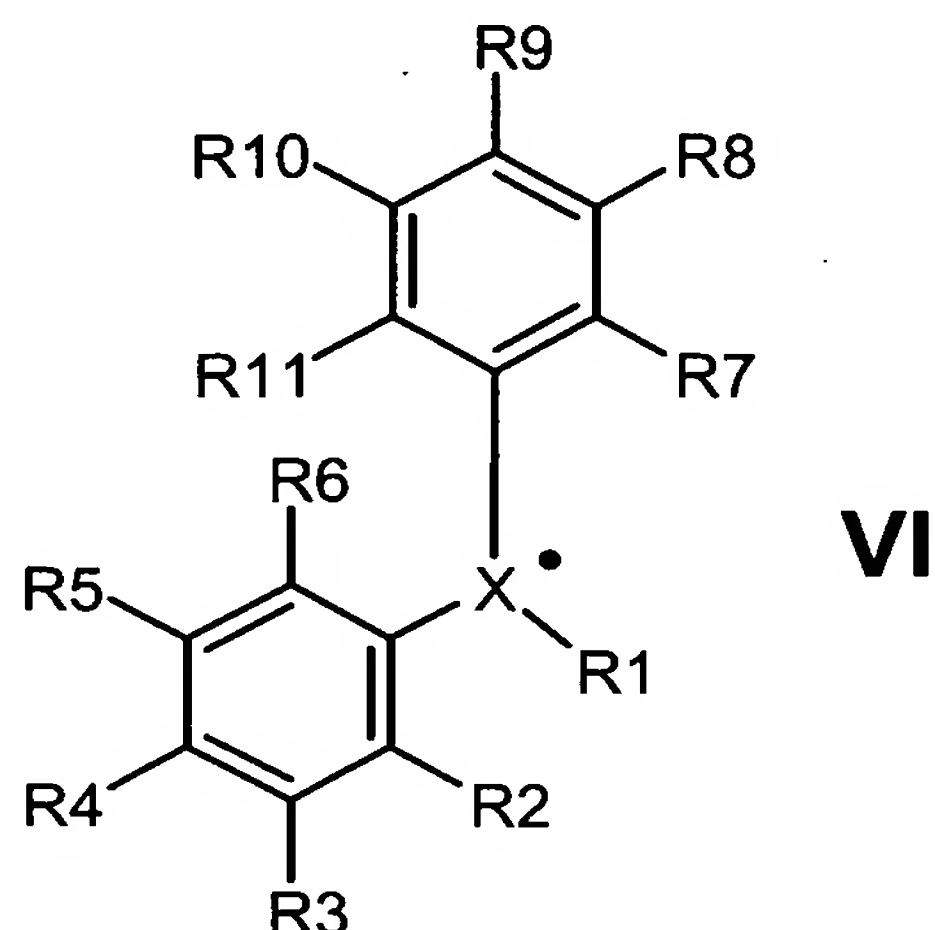
20. (cancelled)

21. (currently amended) The thermally activatable antioxidant precursor compound of claim 1, wherein one of or both of the free radicals A• and B• are of the formula V:



wherein X represents C₁ or C₁' and R1 to R9 are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R₁₆ (where R₁₆ comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl;

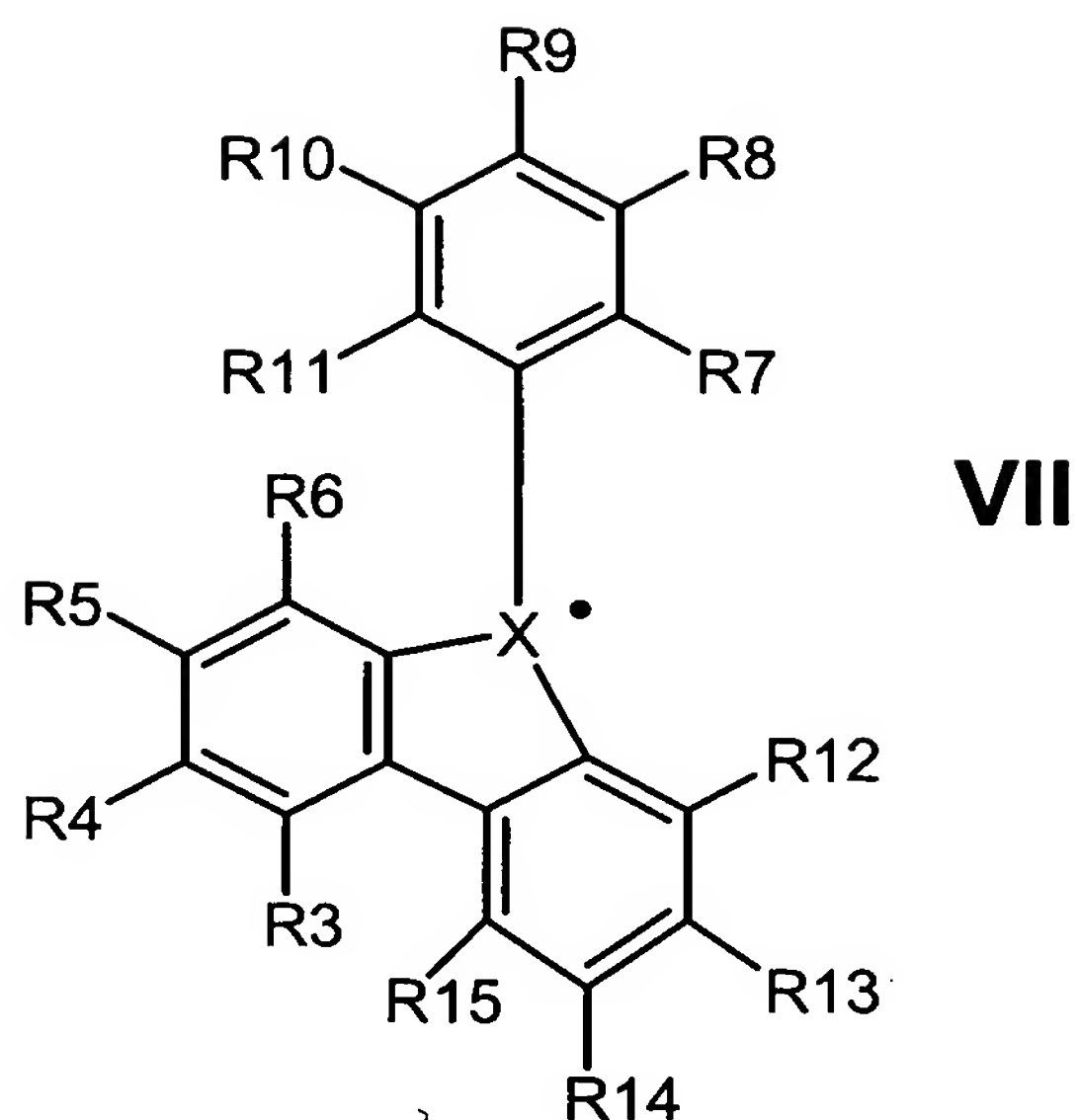
or one of or both of the free radicals A• and B• are of the formula VI:



wherein X represents C₁ or C₁' and R1 represents an electron withdrawing group selected from CN, CHal₃ (where Hal=Cl, Br or F), CO₂R16 (where R16 comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl optionally carrying C₁-C₁₈ alkyl groups, and C₆-C₂₀ aryl), and NO₂;

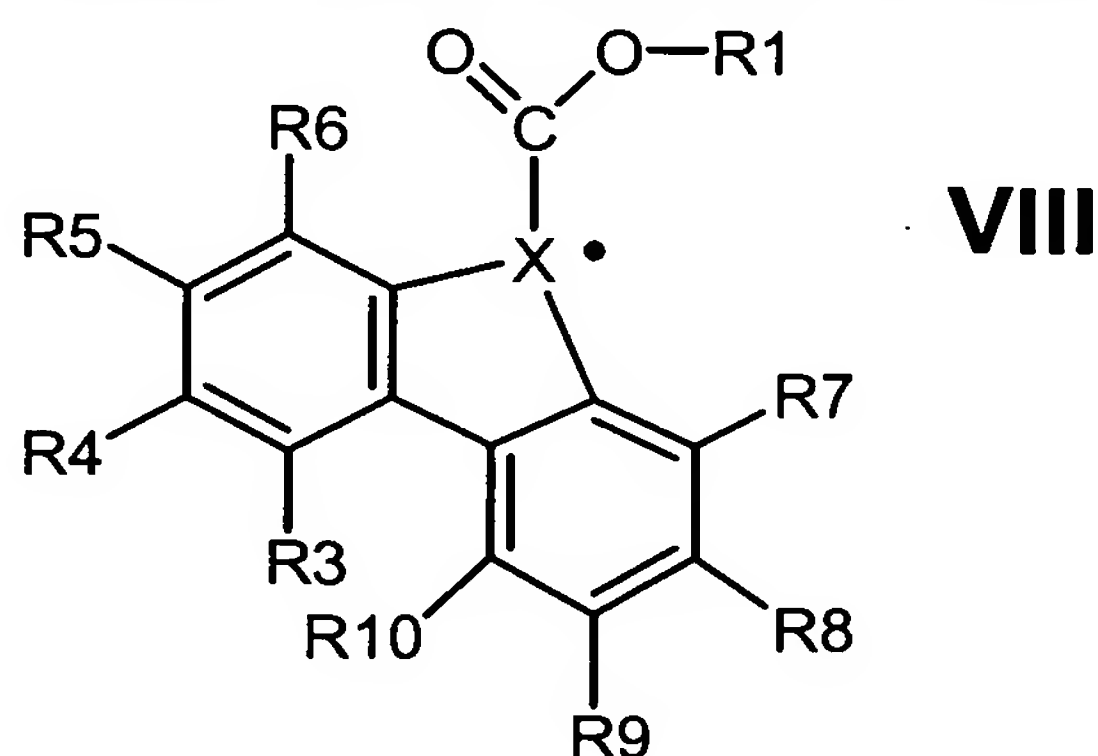
and R2 to R11 are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R16 (where R16 comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl;

or one of or both of the free radicals A• and B• are of the formula VII:



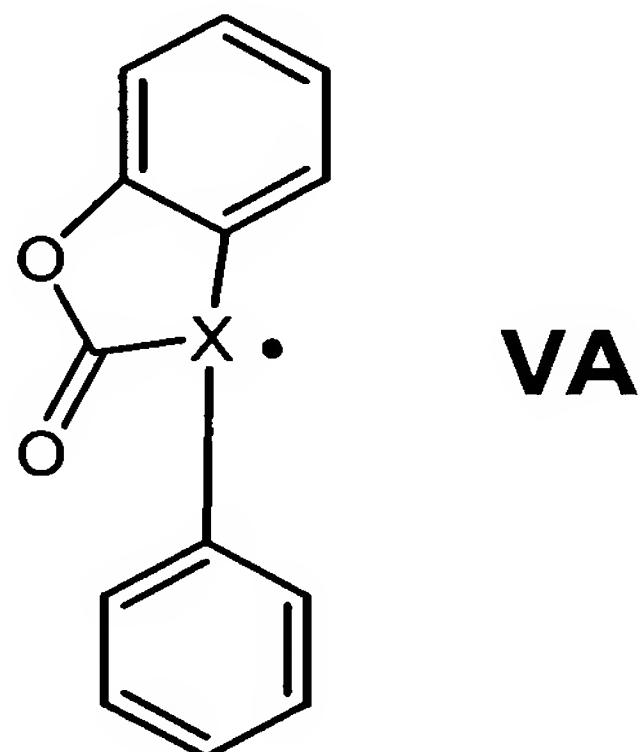
wherein X represents C₁ or C₁' and R3 to R15 are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R16 (where R16 comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl;

or one of or both of the free radicals A• and B• are of the formula VIII:



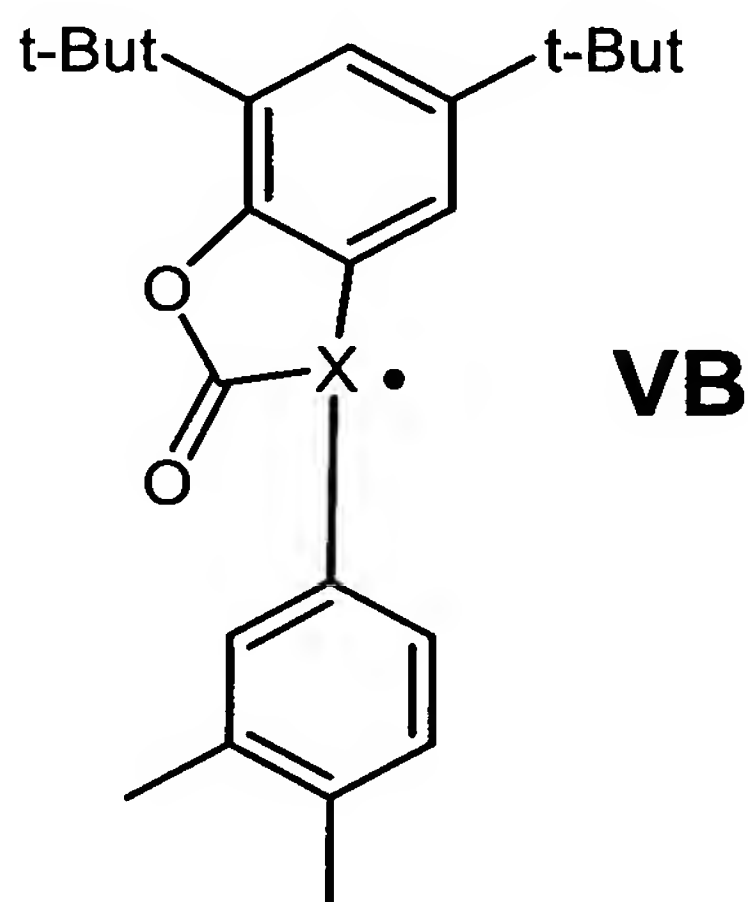
wherein X represents C₁ or C₁' and R1 and R3 to R10 are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R16 (where R16 comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl

optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl;
or one or both of the free radicals A• and B• are of the formula VA:



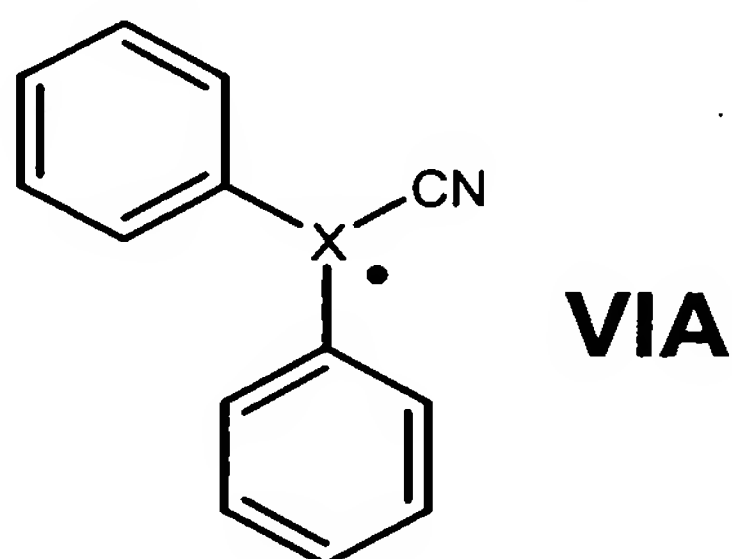
wherein X represents C₁ or C₁';

or either or both of the free radicals A• and B• are of the formula VB:



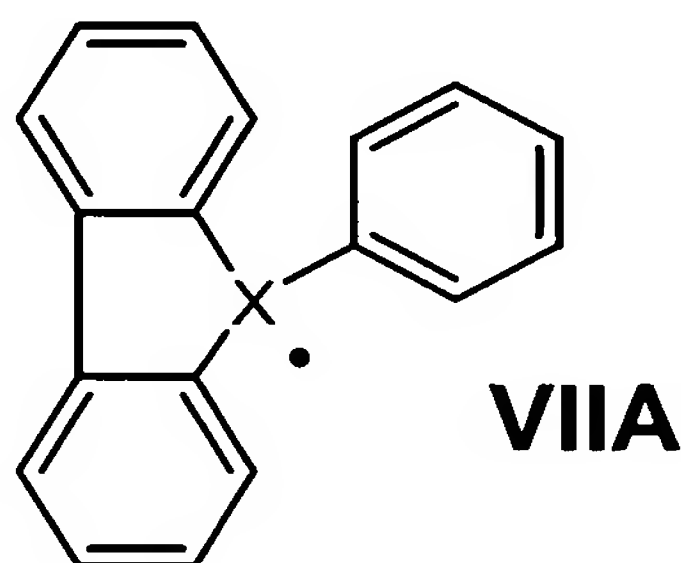
wherein X represents C₁ or C₁';

or either or both of the free radicals A• and B• are of the formula VIA:



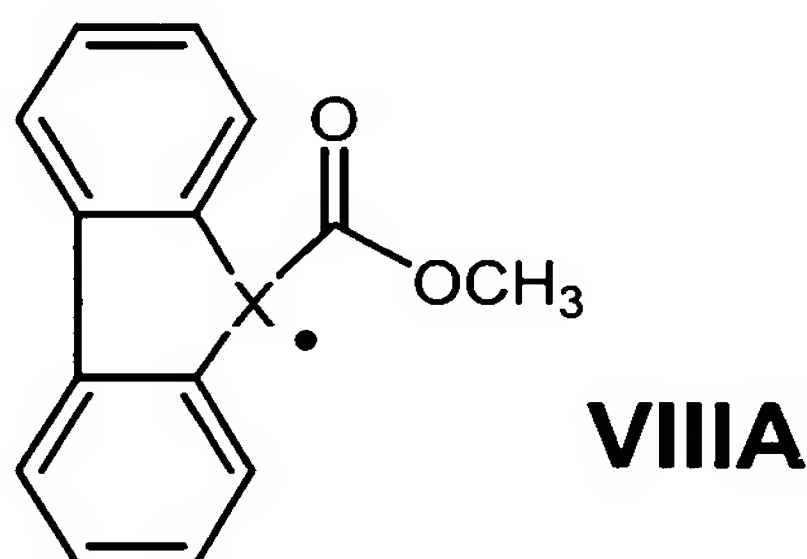
wherein X represents C₁ or C₁';

or either or both of the free radicals A• and B• are of the formula VIIA:



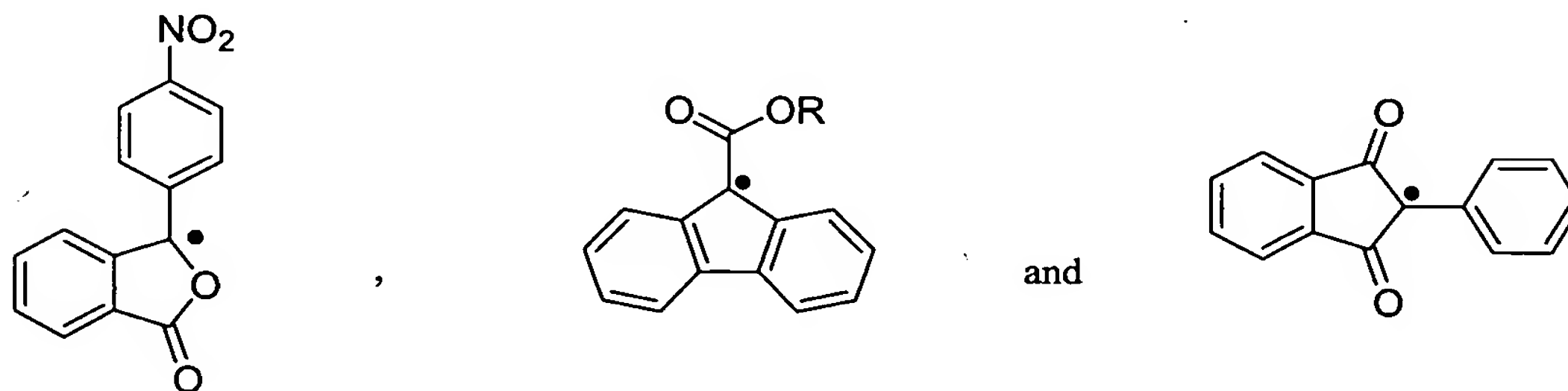
wherein X represents C₁ or C₁';

or either or both of the free radicals A• and B• are of the formula VIIIA:



wherein X represents C₁ or C₁';

or at least one of A• and B• is selected from the group consisting of:

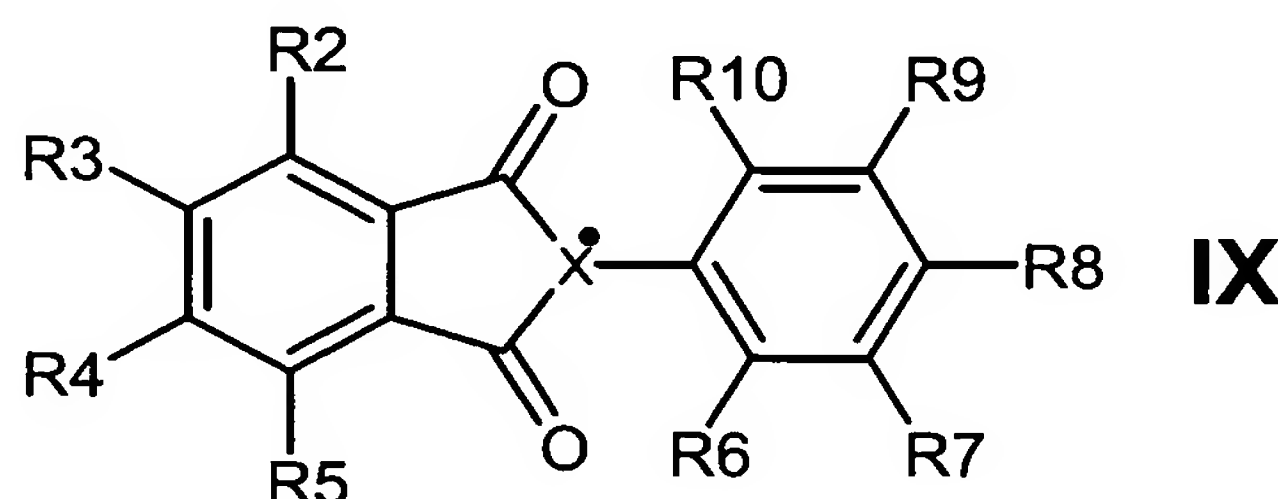


wherein R is selected from hydrogen or a substituent selected from the following group:

linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R16 (where R16 comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl

optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl;

or one of or both of the free radicals A• and B• are of the formula IX:



wherein X represents C₁ or C₁', and R1 to R10 are the same or different, each independently selected from hydrogen or a substituent selected from the following group: linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, CN, CHal₃ (where Hal=Cl, Br or F), CO₂R16 (where R16 comprises hydrogen or a substituent selected from a linear or branched C₁-C₁₈ alkyl, linear or branched C₂-C₁₈ alkenyl, linear or branched C₂-C₁₈ alkynyl, C₅-C₈ cycloalkyl, and C₆-C₂₀ aryl), NO₂, C₅-C₈ cycloalkyl optionally substituted with one or more C₁-C₁₈ alkyl, and C₆-C₂₀ aryl, optionally substituted with one or more C₁-C₁₈ alkyl.

22. (cancelled)

23. (cancelled)

24. (cancelled)

25. (cancelled)

26. (cancelled)

27. (cancelled)

28. (cancelled)

29. (cancelled)

30. (cancelled)

31. (cancelled)

32. (cancelled)

33. (currently amended) The thermally activatable antioxidant precursor compound of claim 1, with the proviso that the compound is not the compound of formula (11) disclosed in United States Patent 5,367,008 or the compound of formula (10) disclosed in United States Patent 5,428,177 or the dimeric form of Irganox HP-136 (Ciba ~~Speciality~~ Specialty Products) or related dimeric products.

34. (currently amended) The thermally activatable antioxidant precursor compound of claim 1, wherein the bond dissociation energy of the labile bond is less than 80 kcal/mol[[.]], preferably less than 50 kcal/mol, more preferably less than 25 kcal mol, most preferably less than 20 kcal/mol.

35. (cancelled)

36. (cancelled)

37. (cancelled)

38. (original) The thermally activatable antioxidant compound of claim 1, wherein said temperature shift is from a lower temperature of from 0°C to 40°C to a higher temperature of from 20°C to 400°C.

39. (currently amended) Use of a compound of the formula:



as defined in ~~any one of~~ claim[[s]] 1 [[to 38]], as a thermally activatable antioxidant precursor compound.

40. (currently amended) A composition comprising: (a) a compound susceptible to oxidation; and (b) the thermally activatable antioxidant precursor compound of ~~any one of~~ claim[[s]] 1 ~~to 38~~, wherein the compound (a) is optionally more susceptible to oxidation at a higher temperature than at a lower temperature.

41. (cancelled)

42. (currently amended) A method for generating an antioxidant, the method comprising the steps of:

a) providing an antioxidant precursor compound of the formula:



as described in ~~any one of~~ claim[[s]] 1 ~~[[to 38]]~~; and

b) adjusting the temperature of A-B to thereby cause dissociation of the compound into free radicals A• and B•~~[[.]]~~ at least one of which is suitable for use as an antioxidant.

43. (original) The method of claim 42, wherein the step of adjusting comprises shifting the temperature of the antioxidant precursor compound from a lower temperature of from 0°C to 40°C to a higher temperature of from 20°C to 400°C.

44. (cancelled)

45. (original) The method of claim 43 wherein the antioxidant precursor compound can be at least in part reformed at said lower temperature; step b) comprising heating the antioxidant precursor compound to said higher temperature, the method further comprising step c) cooling the free radicals A• and B• formed in step b) to said lower temperature to thereby cause at least partial reassociation of the free radicals A• and B• into the thermally activatable antioxidant precursor compound A-B.

46. (cancelled)

47. (currently amended) A method of preventing or slowing oxidation of at least one molecule susceptible to oxidation in a reaction mixture or target environment, the method comprising the steps of:

a) providing an antioxidant precursor compound of the formula:



as described in ~~any one of~~ claim[[s]] 1 [[to 38]];

b) adding the compound to the reaction mixture or target environment; and

c) if necessary adjusting a temperature of the reaction mixture or target environment to a temperature sufficient to cause dissociation of the compound into free radicals A• and B•.

48. (original) The method of claim 47, wherein the step of adjusting comprises shifting the temperature of the antioxidant precursor compound from a lower temperature of from 0°C to 40°C to a higher temperature of from 20°C to 400°C.

49. (cancelled)

50. (cancelled)

51. (original) The method of claim 48, wherein the method involves a thermal cycle comprising a lower temperature portion following a higher temperature portion, the method further comprising step d) cooling the reaction mixture or target environment to the lower temperature portion of the thermal cycle thereby to cause at least partial reassociation of A and B to form the thermally activated antioxidant precursor compound A-B.

52. (cancelled)

53. (original) A composition comprising at least one molecule susceptible to oxidation, and two or more compounds according to claim 1, each of said two or more compounds having alternative combinations of moieties A and B.

54. (original) The composition of claim 53, wherein each of said two or more compounds comprises a labile bond having a bond strength that is different from all other compounds of said two or more compounds.

55. (cancelled)

56. (currently amended) A method for synthesizing the thermally activatable antioxidant precursor compound of claim 1, the method comprising the steps of:

a) providing a mixture comprising A-H, B-H and tert-butyl peroxide, wherein each H is a hydrogen atom[[]] and each moiety A and B is the same or different; and

b) performing a photolysis reaction, preferably at about 350 nm, to produce t-BuOH and A-B.

57. (cancelled)

58. (cancelled)